

Ambient Groundwater Monitoring

in King County, Washington

Ken Johnson

King Co. Dept Natural Resources & Parks
ken.johnson @ metrokc.gov

GO →

- ❑ Overall theme: ***“This is NOT just a study, but rather long term monitoring.”***
- ❑ Groundwater **monitoring** = sampling & analysis, and interpretation
- ❑ **“Ambient”** = *where to look when you are **not** looking for something*
- ❑ Organization of talk: **What, why, where, when, how** (including results)

Apologize for rush through slides

Where (in the world) is King County?

You are here

Background

- ❑ Groundwater Management Areas (GWMA) and *Plans*
- ❑ *Monitoring (1989 – 1993)*
- ❑ GW Protection Ordinance (KCC 9.14) mandates data mgmt, monitoring, data “clearinghouse”
- ❑ Built-up public demand

Objectives

- ❑ **Pilot detection monitoring**
- ❑ **Water levels**
- ❑ **Trends (10-year interval)**
- ❑ **“Background” concentrations**
- ❑ **Contaminants / areas of concern**
- ❑ **Aquifer processes**

Where?

☐ **4 GWMAAs**

- same wells as previously sampled

☐ **Water supply wells**

- Individual domestic supplies
- Public water systems
- Springs

☐ **Representativeness**

- aquifers, water supply areas

☐ **Away (?) from known contamination**

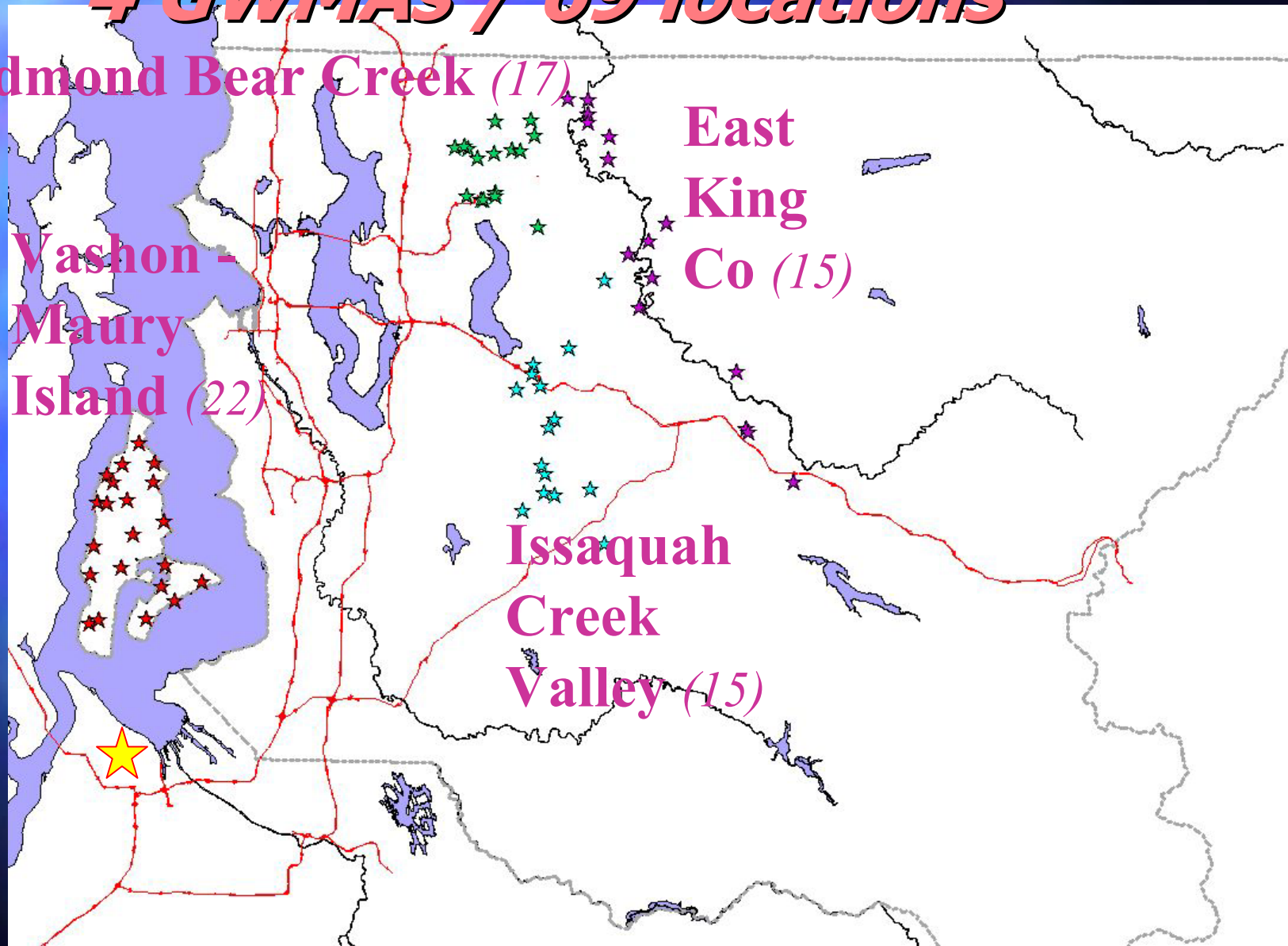
4 GWMA's / 69 locations

Redmond Bear Creek (17)

**East
King
Co (15)**

**Vashon -
Maury
Island (22)**

**Issaquah
Creek
Valley (15)**



Sampling

- ❑ **Water supply wells, using well pumps**
- ❑ **Wet/dry seasons, 2001 & 2002**
- ❑ **SAP / procedures**
- ❑ **Water level (where possible)**



Chemical Analysis

- ❑ **Total -- non-filtered**
- ❑ **Criteria**
 - health concerns
 - likelihood of detection
 - simplicity of analysis
 - completeness (ionic balance)
- ❑ **Detection limits**
 - sampling methods for previous analyses
 - below MCLs

Chemical Parameters

- ❑ **Inorganics / conventionals**
- ❑ **Include P, NH₃, SiO₂, SO₄ (add Fe⁺²)**
- ❑ **Coliform bacteria (fecal & total)**
- ❑ **Field parameters (add Eh)**
- ❑ **Organics (1 sampling round)**
 - volatiles (VOCs)
 - semi-volatiles (BNAs, TICs)
 - some herbicides / pesticides

Data Analysis

□ **Statistics**

- **regression** (old vs new)
- **Student's t** statistic for averages
- some **non-parametric** tests required
- some very simple tests (e.g., new > old?)

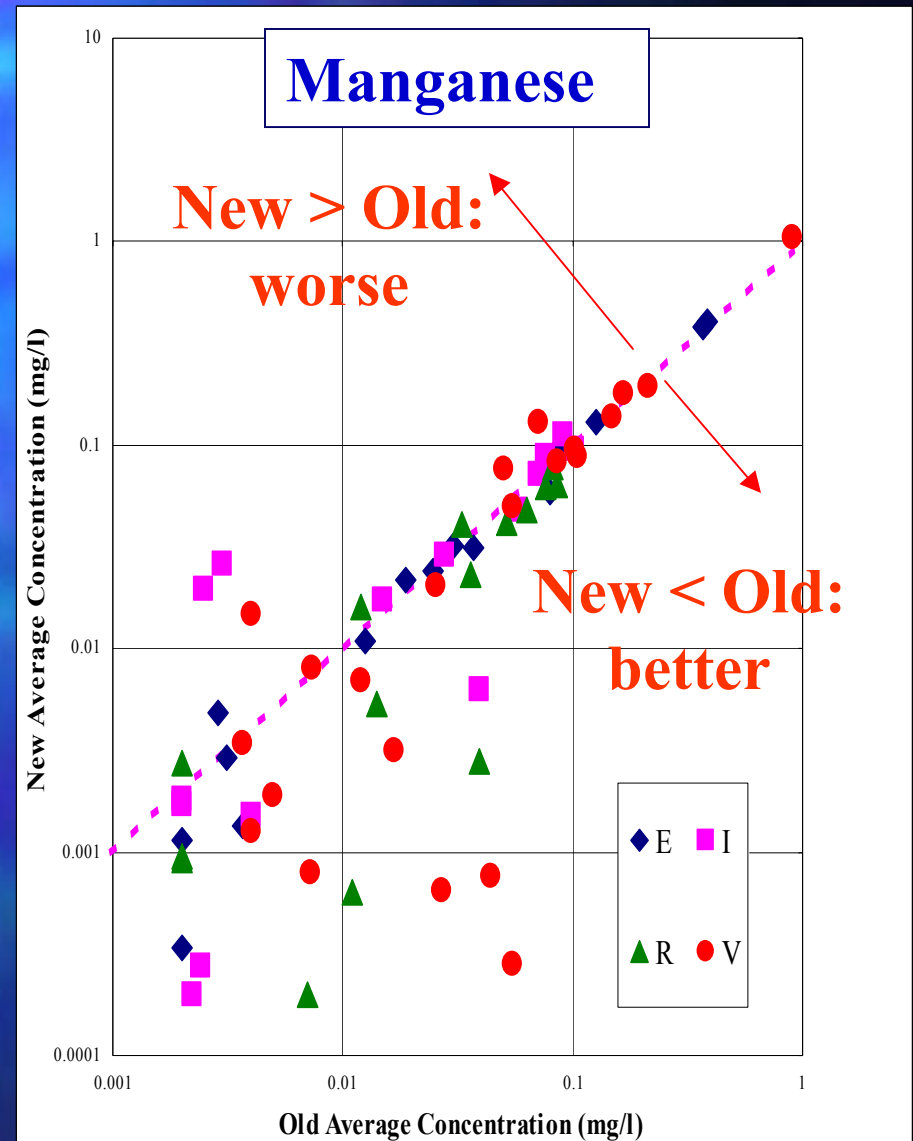
□ **Scatter diagram: old vs new**

□ **Other factors (depth, geochemistry)**

□ **Complications**

Old vs New

- ❑ Scatter-plot well concentration averages -- (old, new)
- ❑ Trends:
 - Equals line at 45°
 - Above line is "bad"
 - Below line "good"
- ❑ Note variability (especially, close to DL)
- ❑ See Manganese →

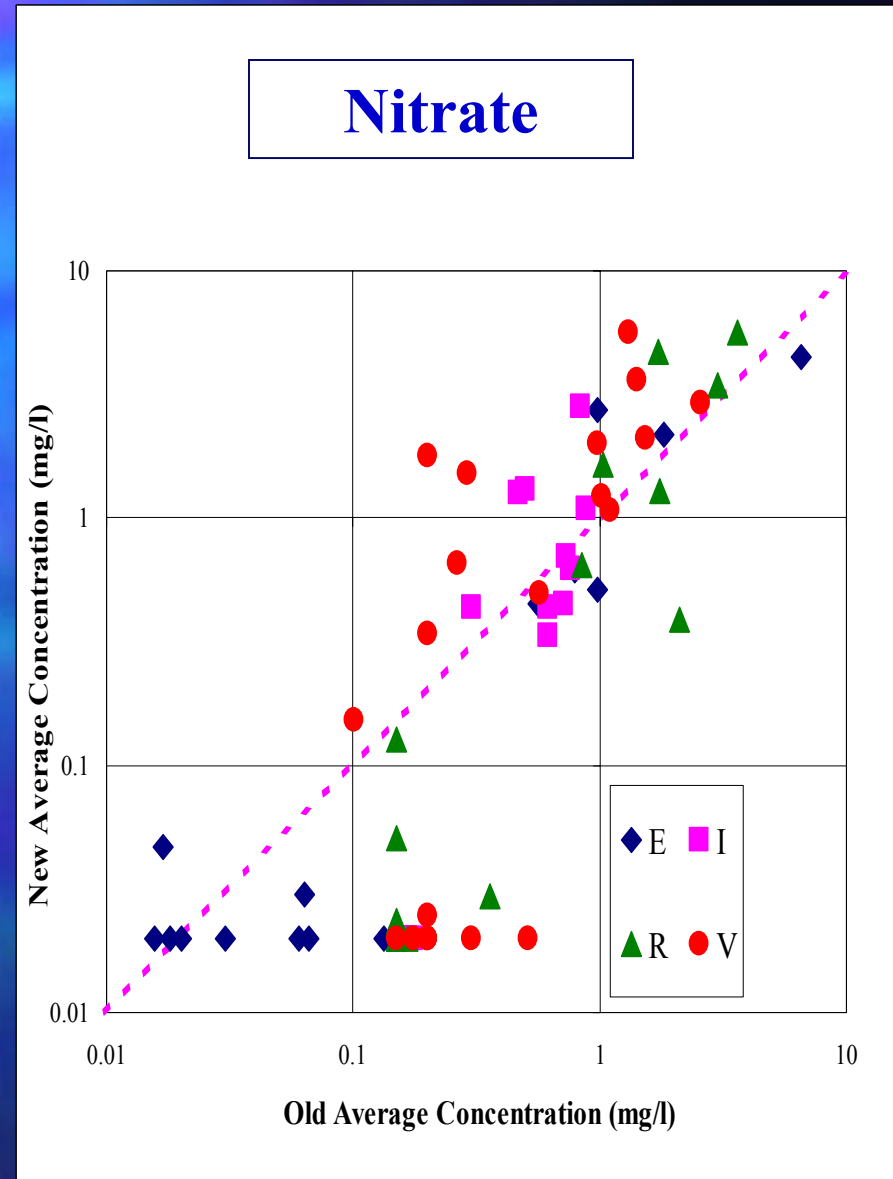


Results

- **Generally: concentrations now LESS THAN concentrations in 1989-1995**
 - --> Improvement in water quality
- **Change of average concentrations are statistically significant for:**
 - **Zinc, Chromium, Lead, Fluoride, Copper** *(preliminary, not including 4th round)*
 - also looked at depth of well and GWMA
- **But ...**

... but

- **Nitrate** appears worse
- See increase on Vashon (red ●s)
- Two populations?
- Shallow vs deep



Results (continued)

- **Comparison to MCLs / exceedances**
 - **Arsenic** (new MCL = 10 ppb)
 - total (& fecal) **coliform** bacteria
 - **nitrate**
 - **lead**
 - secondary (**iron, manganese, sodium**)
- **Others: max < 0.5 MCL** (*generally*)
 - TDS, Zn, F, Cl, SO₄, Cr, Cu, Ni, Ba
 - not detected but close? Tl, Hg, Sb

Results (continued)

- **“Detections” of organics (< 1 ppb)**
 - **bis** (2-ethylhexyl) phthalate (*all 66 locations*)
 - other **phthalates**: di-n-butyl (*30*), diethyl (*9*), benzyl butyl (*9*); **phenol** (*10*); **benzoic acid** (*7*)
 - VOCs: **TCE, PCE, Chloroform** (*1*)
 - **phenanthrene** (*1*)
 - **atrazine** (*1*)
 - **coprostanol** (*1*)

Surprise: no caffeine ! (< 24 ppt)

Uses

- ❑ **Early detection of impacts**
 - from various land uses
 - other policy changes
- ❑ **Intra- / inter-sampling round (RPD)**
- ❑ **Further study / complications**
 - delineate **areas of concern --> focussed sampling**
 - aquifer / depth / geochemical water type
 - outliers

Next steps?

- ❑ **Extend to other areas** (South King Co GWMA, Cedar R. Valley, Enumclaw)
- ❑ **Access other wells** that were not found / not sampled yet
- ❑ **Explore** trends, outliers, seasonality, aquifers; check with purveyor/WoH data

**But: Funding & change of emphasis
will limit level of effort**

Closure

- ❑ Started by saying this was “**Not just a study**”
- ❑ Rather: the start of a *long-term watch*
- ❑ “**Study**” = *when you come up clean, you are “done”* (consultants, ask your clients)
- ❑ Here: **clean = just starting**
dirty = failed to protect

End